

Appl. N . 09/838,070
Amdt. Dated N vember 21, 2003
Reply to Office Action of September 25, 2003

REMARKS/ARGUMENTS

In a concurrently filed *Request for Removal of Finality of Office Action*, Applicants have set forth the reasons that the Office Action of September 25, 2003 is believed to have been made final prematurely. Applicants respectfully request withdrawal of finality of the Office Action of September 25, 2003, consideration of the foregoing amendments and the following remarks and arguments, and withdrawal of the outstanding rejections. In the Office Action (1) an amendment is objected to under 35 U.S.C. § 132 as containing new matter, (2) certain claims stand rejected under 35 U.S.C. § 103(a), and (3) certain claims stand rejected under 35 U.S.C. § 102(b).

Status of the Claims

Claims 1, 2, 15, 16, 28, 29, 35 and 36 were previously canceled.

No claims are currently amended.

Claims 3-14, 17-27, 30-34 and 37-43 are pending.

Objection Under 35 U.S.C. § 132

The Office Action of September 25, 2003 objects to the amendment made to paragraph 0018 of the specification, *i.e.*, "the feed stream is preheated to at least about 350°C, and more preferably to about 400°C." It is said that the added material constitutes new matter. Therefore, paragraph 0018 of the specification is currently amended to return to its original wording. It is Applicants' intention to preserve in the specification a recitation of the option of preheating the feedstock to at least about 350°C, as originally stated in now-canceled claim 28. Accordingly, a new paragraph 0018.1 has been added reciting *verbatim* the text of original claim 28.

Rejections Under 35 U.S.C. § 103(a) Over Mercera et al., Hershkowitz et al. and Jacobs et al.

Claims 3, 4, 6-14, 17-19, 21-27, 30, 31, 33, 34 and 41-43 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Mercera et al. (WO99/37580) in view of Hershkowitz et al. (U.S. Patent 5,883,138) and Jacobs et al. (U.S. Patent 5,510,056). On page 4, first paragraph, it is said that

... it would have been obvious to one of ordinary skill in the art to modify the teachings of Mercera et al. by having a monolithic porous metal foam comprising rhodium and having 75-90% by volume pores and 20-100 pores per inch pore size, because Hershkowitz et al. teaches a catalyst may be comprised of rhodium wherein the catalytic partial oxidation zone may be comprised of a ceramic or metallic foam monolith and Jacobs et al. teaches wherein it is known in the art to have metal coated monolith structures having a porosity of 30 to 50 pores per inch. Furthermore, it would have been obvious to expect at least 75-90% by volume pores, since the monolithic porous metal foams are porous and exhibit the instantly claimed pores per inch. Also, it would have been obvious to one of ordinary skill in the art, since both Hershkowitz et

Appl. N . 09/838,070

Amendment Dated November 21, 2003

Reply to Office Action of September 25, 2003

al. and Jacobs et al., both teach having rhodium and metallic foam monolith structures. Such modification of Mercera et al. would have been obvious to one of ordinary skill in the art, since Mercera et al., Hershkowitz et al., and Jacobs et al. are directed towards partial oxidation processes, using rhodium on foam substrates.

In reply, Applicants' respectfully traverse for at least the reason that a teaching of a porous ceramic foam monolith carrier (Jacobs et al. at col. 2, ll. 10-20 and col. 5, ll. 39-64), even one having similar pore geometry and void fraction similar to Applicants', still does not constitute a teaching of the same porous metal foam monolith containing rhodium of Applicants' claims 3-14, 17-27, 30-34, or 37-43. It is very well known in the art that a metal coated ceramic support does not have the same characteristics and capabilities as a "bulk" metal monolith. For instance, the coefficient of thermal expansion (CTE) and the thermal conductivity (heat transfer) properties would be different for the two structures under catalytic partial oxidation process conditions. Ceramic materials are typically more thermally insulative than metals. Ceramic foam supported catalysts are also prone to disintegration during use due to thermal shock or due to collapsing under superatmospheric pressure, especially when subjected to prolonged use on stream at high pressure and high space velocities, whereas metal catalyst structures are less prone to such failures. Attached in support of this position are pages from STRUCTURED CATALYSTS AND REACTORS, A. Cybulski and J. Moulijn, Eds., Marcel Dekker, Inc., New York, NY (1998), a reference book which is well known to those of skill in the art. Pages 26-27 of that book describe how key thermal properties differ in ceramic structures due to microstructure differences. One of skill in the art would recognize that differences in thermal properties between ceramic structures and metal structures would be even greater. Pages 60-67 from the same reference describe bulk-metal catalysts, in the form of metal powders, granules, metal-gauzes, shaped structures (e.g., spheres, rings/cylinders, saddles, etc.), and coated-metal substrates. One of ordinary skill in the art at the time Applicants' invention was made would appreciate that the dispersion of the catalytic metal crystallites over the surface area of a ceramic support differs from the catalytic metal surface area of a rhodium or rhodium-platinum foam monolith. More specifically, in a metal foam all of the metal surface area exposed to the reactant gases is potentially catalytic surface area; whereas with a metal-coated ceramic structure, only a fraction of the surface area is catalytic. It is noteworthy that this discussion of bulk metal catalysts in the above named art-recognized reference makes no suggestion of a metal foam catalyst.

It is also well known to one of ordinary skill in the art that catalytic metals dispersed on a ceramic support oftentimes combine chemically and/or physically with the support material, effectively

Appl. No. 09/838,070
Amendment Dated November 21, 2003
Reply to Office Action of September 25, 2003

removing catalytic sites for carrying out the catalytic partial oxidation reaction. The Fujitani et al. reference notes at col. 2, ll. 43-47 that when the amount of rhodium on the carrier is too low, a lowering in the catalytic activity results, thereby presenting the possibility of carbon depositing on the catalyst (coking) because of the attendant need to use a high temperature for partial oxidation. Thus, one would expect that coking tendency during use could differ from a ceramic monolith supported catalyst to a metal foam monolith catalyst. The susceptibility of a catalyst to carbon deposition and/or to degradation due to temperature fluctuation or gas pressure are widely known factors that affect the longevity or useful lifetime of the catalyst on stream.

For at least these reasons, the catalytic performance in a short contact time reactor for production of synthesis gas would be expected to differ with a ceramic foam supported rhodium catalyst compared to an all-metal rhodium foam monolith catalyst. These differences would be expected even when the pore geometry of the ceramic monolith and the metal monolith were similar. There is no adequate teaching in the combined teachings of the cited references from which one of skill in the art could be guided to model a rhodium foam monolith on a rhodium coated porous ceramic monolith, and to use the resulting catalyst in the process of Hershkowitz, with a reasonable expectation of achieving Applicants' claimed process. Without Applicants' disclosure, it could not be predicted or reasonably expected that a metal foam monolith catalyst containing rhodium and having 75-90% pore volume and 20-100 pores per inch would be capable of providing the claimed selectivities (claims 30, 37) or longevity (claims 41 and 42), for example. Even varying the number of ceramic monolith disks, as suggested in the Office Action, based on the combined teachings of the references, could not be reasonably expected to provide exactly the same activity and physical characteristics of the rhodium foam disks of Applicants' claims 30 and 43.

Even if similar operating temperatures (claims 6-8, 21-23 and 30), pressures (claims 9, 24 and 30), space velocities (claims 14, 27 and 30) and feed composition (claims 10, 18, 25, 26, 31 and 34) are described by the combined references, this would not make up for the lack of teaching of the precise catalyst composition and characteristics (claim 3), or its activity (claims 17, 30, 37) and longevity (claims 41 and 42) when used on stream to partially oxidize a hydrocarbon feedstock to produce carbon monoxide and hydrogen. With respect to claims 41 and 43, for example, there is no indication in the Office Action as to how the combined teachings of Mercera et al., Hershkowitz et al. and Jacobs et al. would have made it obvious to one of ordinary skill in the art to achieve the desired catalyst activity duration times in a process. As discussed above, carbon deposition and catalyst disintegration are

Appl. No. 09/838,070
Amendment Dated November 21, 2003
Reply to Office Action of September 25, 2003

common variables that shorten catalyst life. It is well known that the activity of a catalyst soon after start up of the process can differ markedly from the activity of the same catalyst after hours or days of use. The combined references do not teach or suggest the claimed catalysts compositions or the processes using those catalysts, much less suggest their longevity in use.

It should also be noted that the combined teachings of the cited references do not provide guidance to one of ordinary skill in the art at the time Applicants' invention was made as to how to make a monolithic porous metal foam catalyst with the same characteristics and properties as required in the process of Applicants' claims 3, 4, 6-14, 17-19, 21-27, 30, 31, 33, 34 and 41-43. It is acknowledged in the Office Action that "Mercera et al. does not disclose wherein the monolithic porous metal foam comprises rhodium and has a 75-90% by volume pores and 20-100 pores per inch pore size." It is also clear that the mere suggestion of a metallic foam monolith (col. 4, l. 66 of Hershkowitz et al.), for a catalytic partial oxidation process, even combined with the teachings of Mercera et al. and Jacobs et al., is insufficient to render the catalyst of the claimed process obvious.

Rejections Under 35 U.S.C. §103(a) Over Mercera et al./Hershkowitz et al./Jacobs et al./Fujitani et al.

Claims 5, 20 and 32 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Mercera et al. in view of Hershkowitz et al. and Jacobs et al., as applied above, and further in view of Fujitani et al. (U.S. Patent 4,087,259). It is said that Fujitani et al. teaches using rhodium in the form of a metal or in the form of an oxide (col. 2, ll. 30-33). In reply, Applicants submit that even if the teachings of the references were combined as suggested in the Office Action, and the rhodium were oxidized according to Fujitani et al., there would still be no adequate teaching of how to make a rhodium foam monolith having the claimed characteristics and properties. If one of ordinary skill in the art to try to make an oxidized rhodium metal catalyst modeled after the rhodium-coated ceramic foam monolith catalyst of Jacobs et al., there would be insufficient guidance in the teachings of the combined references to accomplish that result. Considering the above-discussed differences between ceramic monolith supported catalysts and bulk metal catalysts, there could be no reasonable expectation that any metal foam monolith catalyst that was modeled in some fashion upon the geometry of a ceramic foam monolith catalyst based on the combined teachings of Mercera et al., Hershkowitz et al., and Jacobs et al., would result in exactly the same properties and characteristics as the catalyst employed in claim 5, 20 or 32, or that it would function in a catalytic partial oxidation process as claimed by Applicants.

Appl. No. 09/838,070
Amendment Dated November 21, 2003
Reply to Office Action of September 25, 2003

Rejections Under 35 U.S.C. § 102(b) Over Jacobs et al.

Claims 37, 39 and 40 are rejected under 35 U.S.C. § 102(b) as anticipated by Jacobs et al. It is said that the catalyst composition of Jacobs et al. may comprise rhodium and be in the form of a monolithic foam structure (col. 5, ll. 39-64), and that it is known in the art to have metal coated monolith structures having a porosity of 30-50 pores per inch (col. 2, ll. 10-20). Applicants respectfully traverse this rejection for substantially the same reasons as stated above with respect to the Jacobs et al. reference. A metal coated ceramic monolith is not the same thing as a porous rhodium foam monolith, even if there are some similarities of pore configuration. A suggestion of a catalyst composition that comprises rhodium (col. 5, ll. 26-38 of Jacobs et al.), especially where only rhodium loading on a porous ceramic foam of defined pore arrangement and tortuosity is exemplified, does not amount to a teaching of the same catalyst as claim 37.

With respect to claim 39, there is no teaching in Jacobs et al. of how to make a porous rhodium foam monolith. There is also no teaching of how to make the same platinum-containing catalyst as Applicants' claim 40, for the same reason as discussed above with respect to claim 37. Moreover, since there is no reasonable basis for assuming that the rhodium coated ceramic monolith of Jacobs et al. is exactly the same as the rhodium foam monolith of claim 37, it is apparent that the foam pyrolyzation method included in claim 39 would also necessarily result in a different catalyst composition than that of Jacobs et al.

Rejections Under 35 U.S.C. § 103(a) Over Jacobs et al.

Claims 37, 39 and 40 stand rejected in the alternative under 35 U.S.C. § 103(a) as obvious over Jacobs et al. In reply, Applicants traverse this rejection for at least the reason that even if one were motivated to try to make a porous rhodium foam monolith matching the geometry of the ceramic monolith of Jacobs et al. and having the H₂ selectivity stated in Table 1 of Jacobs et al., there is no teaching in Jacobs et al. of how to do so. Moreover, given the well-known differences in the properties and performance of ceramic monoliths vs. metal foam monoliths, there would be no reasonable expectation that a metal foam catalyst having the same pore configuration as a ceramic monolith catalyst would have all of the same characteristics and properties of the catalyst of Applicants' claim 37, 39 or 40. In fact, the Jacobs et al. reference appears to dissuade one from using more than 5 wt% rhodium, since CH₄ conversion, CO selectivity and H₂ selectivity are all 90% or better using a ceramic monolith loaded with only 5 wt% rhodium. Jacobs et al. state at col. 4, ll. 1-9 that when the porosity

Appl. No. 09/838,070
Amendment Dated November 21, 2003
Reply to Office Action of September 25, 2003

and tortuosity of the catalyst bed meet the stated criteria, the amount of catalytically active metal present in the catalyst can be reduced while maintaining a high level of activity and selectivity. The artisan would also consider the statement in the Fujitani et al. reference that rhodium is expensive (col. 2, ll. 35) and when the rhodium content in the catalyst is greater than 1 wt%, there is no corresponding increase in the catalytic activity, even when the content is increased by a considerable degree (col. 2, ll. 47-51). With respect to claim 40, which depends from claim 37, even if inclusion of platinum in the catalyst of Jacobs were obvious, the catalyst composition of claim 40 would still be different for the same reasons as claim 37.

Rejections Under 35 U.S.C. § 103(a) Over Jacobs et al. and Fujitani et al.

Claim 38 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Jacobs et al., as applied to claims 37, 39 and 40, above, and further in view of Fujitani et al. The Office Action acknowledges that Jacobs et al. does not teach wherein the foam has been pretreated by exposure to air under conditions sufficient to oxidize the rhodium. However, the Office Action takes the position that Fujitani et al. teaches that a rhodium catalyst, which is used in a process for partially oxidizing hydrocarbons to a synthesis gas, exhibits consistent activity either in the form of a metal or in the form of an oxide (col. 2, ll. 30-33 of Fujitani et al). As discussed above with respect to the rejection of claims 5, 20 and 32, even if the rhodium in the catalyst of Jacobs et al. were oxidized according to Fujitani et al., there would still be no adequate teaching of how to make an oxidized rhodium foam monolith modeled in some fashion upon the geometry of a ceramic foam monolith catalyst and having the claimed characteristics and properties of Applicant's claim 38.

Applicants respectfully submit that each of the pending claims 3-14, 17-27, 30-34 and 37-43 are free of the cited references.

Conclusion

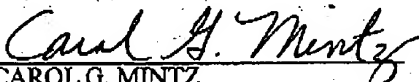
Applicants believe that this is a full and complete response to each rejection, objection and requirement. If any item has been overlooked, Applicants respectfully request the opportunity to supplement this response. The format of this Amendment and Response to Office Action is believed to conform with the Revised Amendment Practice as described in "Changes To Implement Electronic Maintenance of Official Patent Application Records," 68 Fed. Reg. 38611 (June 30, 2003). Applicants may have at times referred to claim limitations in shorthand fashion, or may have focused on a particular claim element. This discussion should not be interpreted to mean that the other limitations

Appl. No. 09/838,070
Amendment Dated November 21, 2003
Reply to Office Action of September 25, 2003

can be ignored or dismissed. The claims must be viewed as a whole, and each limitation of the claims must be considered when determining the patentability of the claims. Moreover, it should be understood that there may be other arguments with respect to patentability which have yet to be raised, but which may be raised in the future.

If any issues remain unresolved, Applicants respectfully request a telephonic Examiner Interview to facilitate the resolution of such matters. Should any fees have been inadvertently omitted, or if any additional fees are required or have been overpaid, please appropriately charge or credit those fees to Deposit Account Number 03-2769 of Conley Rose, P.C., Houston, Texas, and consider this a petition for any necessary extension of time.

Respectfully submitted,


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AGENT FOR APPLICANTS